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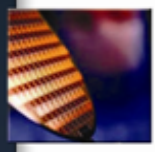
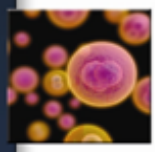
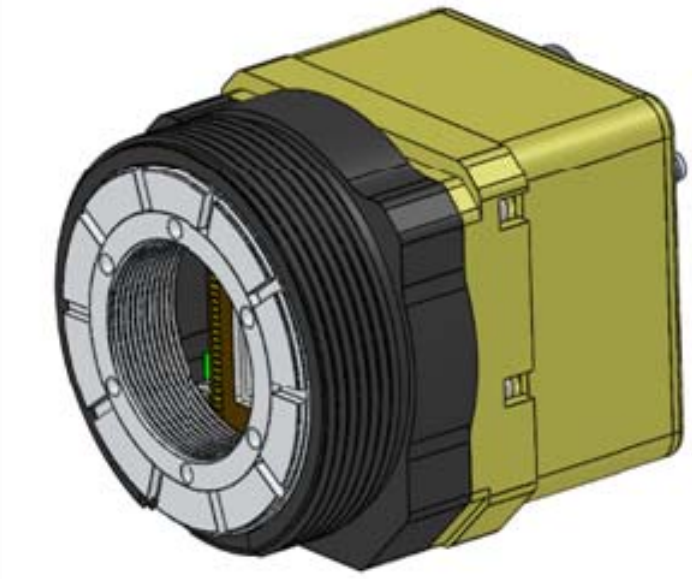
Performance Visible, Low-Light, and SWIR Camera Solutions





Tau CNV
User's Manual



Tau Color Night Vision Camera

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FLIR Advanced Imaging Systems, Inc.

FLIR Advanced Imaging Systems (AIS) produces a wide range of high performance cameras for applications that demand high resolution, high data rates, wide dynamic range, high sensitivity (low light), low power and small form factors (space claim) packaging. FLIR AIS satisfies the needs of our customers by applying the best camera sensor technologies to our customers' challenging applications, and coupling these sensor technologies with low noise and precision analog design, proprietary thermal stabilization, and real-time image processing. FLIR AIS' cameras are designed and built in our ISO certified facility and each camera is 100% tested and inspected using the photon transfer curve methods and best manufacturing practices to verify performance to technical specifications and to ensure total product quality.

FLIR AIS designs, develops, and manufactures its high performance cameras at its facility in Colorado Springs, Colorado, USA, and is part of FLIR Systems Inc., a world leader in the design, manufacture, and marketing of sensor systems that enhance perception and awareness for a wide variety of users in the commercial, industrial, and government markets, internationally as well as domestically.

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Table of Contents

1 INTRODUCTION 6
2 CAMERA POWER 6
2.1 IMPORTANT SYSTEM GROUNDING REQUIREMENTS 6
2.2 IMPORTANT POWER-UP SEQUENCING REQUIREMENTS 6
2.3 IMPORTANT CLEANING AND LENS INSTALLATION INFORMATION 6
3 CAMERA FEATURES AND FUNCTIONS 7
3.1 HIGH DEFINITION, 1280 X 1024 IMAGER 7
3.2 PROGRAMMABLE ELECTRONIC SHUTTER 8
3.3 AUTOMATIC GAIN CONTROL 8
3.4 AUTOMATIC COLOR AND WHITE BALANCE 8
3.5 SELECTABLE NOISE SUPPRESSION 8
3.6 INTEGRATED, MOTORIZED, IR CUT FILTER OPTION 9
3.7 TRIGGER MODES - FREE RUN, OR EXTERNAL TRIGGER 9
3.8 FLAT FIELDING (NON-UNIFORMITY CORRECTION) 10
3.9 DIGITAL AND ANALOG VIDEO OUTPUT OPTIONS 10
3.10 SMALL SPACE-CLAIM AND LOW POWER REQUIREMENTS 10
3.11 EFFECTIVE DAY AND NIGHT COLOR THROUGH BUILT-IN FILTER SLIDER (OPTIONAL) 10
4 CAMERA SPECIFICATIONS 11
4.1 CAMERA SPECIFICATIONS 11
4.2 QUANTUM EFFICIENCY (QE) RESPONSE CURVES 13
5 THEORY OF OPERATION 14
5.1 CAMERA LAYOUT 14
5.2 LENS MOUNT ASSEMBLY 14
5.3 TAU CNV CMOS SENSOR 16
5.4 SENSOR MOUNT AND HEAT SINK 17
5.5 CAMERA ELECTRONICS 17
5.5.1 Sensor Bias and Interface 17
5.5.2 Clock and Control Circuitry 17
5.5.3 Power Conditioning and Distribution 17
5.5.4 Camera Interface 18
6 CAMERA INTERFACING 19
6.1 LVDS PARALLEL DATA COMMUNICATION 19
6.1.1 Power Connector 20
6.1.2 Parallel Data Connector 20
6.2 GROUP INTERFACE 22
6.2.1 Group Interface Default Settings 22
6.2.2 Power Connector 23
6.2.3 Camera Link 23
6.2.4 Analog Video Output and Serial Interface (default configuration) 25
6.2.5 Trigger In/Out 25
6.2.6 Trigger In Mode 26
6.2.7 Trigger Out Mode 26
6.2.8 Video IRIS (future) 26
7 MECHANICAL DETAIL 26
7.1 HOUSING & MATERIALS 26
7.2 DIMENSIONS 27
7.3 LENS MOUNTING AND BACK FOCUS ADJUSTMENT 27

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8 CAMERA MOUNTING & COOLING 28
8.1 ¼ - 20 MOUNTING HOLE (TRIPOD) 28
8.2 IMPORTANT MOUNTING REQUIREMENTS 28
9 COMMAND AND CONTROL OF THE CAMERA 29
9.1 FLIR AIS' CAMERA CONTROL UTILITY 29
9.1.1 Installation 29
9.1.2 Camera Connection Screen 39
9.1.3 GUI Advanced User Mode 42
10 CAMERA CARE AND MAINTENANCE 48
10.1 MAINTENANCE, RETURNS, AND REPAIR 48
10.2 ELECTROSTATIC DISCHARGE (ESD) 48
10.3 COVER GLASS DAMAGE 48
10.4 CLEANING THE CAMERA HOUSING 49
11 REVISION CONTROL 49

List of Figures

Figure 1: Tau CNV Video Camera 7
Figure 2: QE Response Curves for Color Camera and Monochrome Cameras 13
Figure 3: CNV Camera (not shown with optional motorized IR-cut Filter for color camera) 14
Figure 4: Tau CNV Camera with M42 Lens and C-Mount Adapter 15
Figure 5: Tau CNV Camera with M42 Lens Mount, Integrated IR-Cut Filter Slider (color only), and C-Mount Adapter 16
Figure 6: Camera Parallel Interface Back Plate Diagram. 19
Figure 7: Group Interface Back Panel View 22
Figure 8: Camera Link SDR-26 diagram 23
Figure 9: Dimensions 27

List of Tables

Table 1: Tau CNV Camera Specifications [1] 11
Table 2: Parallel Interface, Power Connector 20
Table 3: Parallel Interface Connector Pinout 20
Table 4: Group Interface Default Configuration 22
Table 5: Parallel Interface, Power Connector 23
Table 6: Camera Link SDR-26 Connector Pin Assignment 24
Table 7: USB Mini-B Interface 25
Table 8: TRIG IN/OUT Interface 25

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1 Introduction

Thank you for purchasing the FLIR AIS Tau CNV camera.

This user's manual will give you an overview of the features and functions of your camera, and is part of a document set:

- User's Manual to give you an overview of the camera's features and functions;
- Interface Control Document (ICD) for detailed interface and control information.

Your Tau CNV camera is backed by FLIR's worldwide service and support team. If you do not find the information that you need in one of these documents; please contact your sales representative and we will get your questions answered quickly.

Important Notice: This user manual is subject to change without notice. Please contact your FLIR representative for the latest version of this user's manual.

2 Camera Power

2.1 Important System Grounding Requirements

If you are using the Tau CNV camera with the FLIR 100-240VAC power supply (24-10038-01, 24-20038-01, or 24-30038-01), ensure that a three wire single-phase (hot, neutral, earth-ground) connection is used as supplied with your power supply. Also note that the TAU CNV camera chassis is isolated from the earth-ground connection.

2.2 Important Power-Up Sequencing Requirements

The Tau CNV is designed against damage from hot-swapping; however, we recommend that you do not hot-plug the camera to ensure proper operation. Make all connections to the camera before applying power.

2.3 Important Cleaning and Lens Installation Information

Care is required when installing a lens to prevent dust from entering the lens mount opening. If dust is introduced on the imager surface, on models without the automated Day/Night filter slider, you may clean the surface of the imager using proper cleaning materials and good cleaning techniques for AR coated glass. However, if your camera came with the automated Day/Night filter slider installed, the camera

must be returned to the factory for cleaning since this operation requires disassembly and reassembly of the camera. For this reason, it is recommended that all lens installations be performed under a flow hood if available.

3 Camera Features and Functions

The FLIR AIS Tau CNV (see Figure 1) is an ultra-low light and small form factor video camera with user programmable gain and on-chip electronic shuttering that provides large dynamic range and image processing features that make it suitable for full sunlight to overcast starlight applications.

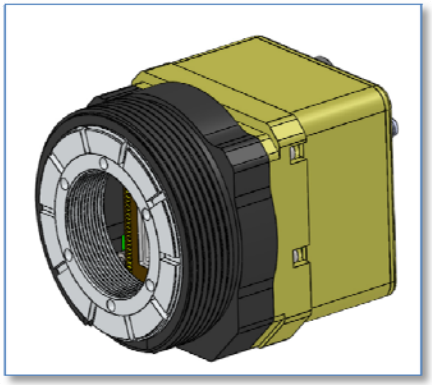

Figure 1: Tau CNV Video Camera

- Color and Monochrome Low Light Imaging
- High Definition, 1280 x 1024 Imager
- Programmable Electronic Shutter
- Automatic Exposure Control
- Automatic Color and White Balance
- Selectable Noise Filtering
- Integrated, Motorized, IR Cut Filter Option
- Free Run or External Trigger Modes
- Flat Fielding (Non-Uniformity Correction)
- Digital and Analog Video Output Options
- Small Space-Claim and Low Power Requirements

3.1 High Definition, 1280 x 1024 Imager

The Tau CNV uses a CMOS imager with a 6.5µm^2 pixel pitch, 5T active pixel type, 1280x1024 high-definition (HD) resolution, and high dynamic range. These features, in addition to the low NEI of < 3E8 photons/cm^2-sec and typical read noise of less than 2 e- make this CMOS technology is a good alternative to larger and lower performance EMCCD and CCD sensor-based cameras.

The camera supports 960 lines per frame (default) or 720 lines per frame. The camera outputs 1280 pixels per line, providing an overall frame resolution of 1280x960 or 1280x720.

3.2 Programmable Electronic Shutter

The electronic shutter "exposure time" (also known as the "integration time") is the amount of time the sensor's light sensitive pixels will collect charge when exposed to light, and is configurable via serial command in increments of a "line time" (see ICD). Even though the camera output is 1280 pixels per line by 960 lines per frame, internal camera functions require 993 lines to be clocked out of the sensor each frame (Camera output includes a "line valid" signal to indicate which lines are the 960 valid image lines). The time it takes to clock out a single line from a frame or "line time" is approximately 32.85us (0.000032853333s). Therefore the minimum frame time for this camera is:

$$minimum\ frame\ time = line\ time * 993\ lines = 32.62ms$$

This corresponds to a maximum frame rate of slightly over 30fps.

Exposure time can be set anywhere from one line time (32.85us) to one line time less that the frame period. At the maximum frame rate this corresponds to 992 * line time or 32.5ms.

The camera may be triggered internally (free running) or externally via the trigger-in pin of the trigger in/out connector or via the Camera Link CC1 line

3.3 Automatic Gain Control

The automatic gain control (AGC) is used to automatically control the brightness and amount of detail in the analog output image. The camera's AGC will adjust the brightness and contrast to a level suitable for viewing on an analog monitor by adjusting exposure (integration) time and histogram processing.

3.4 Automatic Color and White Balance

In the color version, automatic color and white balance are used for optimal image color production on the analog video output. The camera sensor measures discrete green, red and blue color intensities through the use of red, green, and blue filters in a Bayer mosaic pattern. The camera then uses a precision algorithm to combine these three colors to produce optimal color representation of the image to match the human visual system (HVS). Due to the wide variety of lighting, scene and other factors that influence color, the image colors may not be accurately represented in all circumstances.

3.5 Selectable Noise Suppression

The Tau CNV supports noise suppression using image subtraction techniques. Noise suppression allows frame-to-frame noise to be filtered out to improve image quality, especially for low-light imaging applications. The amount of noise suppression is programmable (see Tau CNV ICD). Note: This use of noise suppression can cause image-lag in dynamic scenes.

3.6 Integrated, Motorized, IR Cut Filter Option

The Tau CNV color camera can be purchased with an integrated, motorized, IR-cut filter option. The lens mount assembly hosts a motorized two-glass position filter slider mechanism: (1) a BG38 IR-cut filter for daytime operation to preserve accurate color representation, and (2) a clear glass filter that is used for low-light imaging applications. A motorized assembly moves the appropriate glass filter into place as instructed by a serial command.

3.7 Trigger Modes - Free Run, or External Trigger

The camera has two trigger modes: (1) Internal "free run", and (2) external mode.

When the camera is triggered in Internal (free run) mode, images are continuously output at a frame rate determined by trigger period. Trigger period resolution is in image line times which are approximately 32.85us (0.000032853333s). Valid trigger period settings are from 993 lines (approximately 30fps) to 29,425 lines (about 1fps). See the ICD for details on setting trigger period.

If attempts are made to set the trigger period to values greater than 29,425 lines, camera firmware internally limits the actual setting to the 29,425 line maximum. If the trigger period register is set to values less than 993 lines the camera will trigger erratically as some triggers will be missed.

In internal trigger mode, exposure or integration time is also configured in terms of line times. Minimum exposure time can be set to 0 lines however the minimum useful exposure time is 1 line time or 32.85us. The maximum exposure time is 1 line time less that the period setting. The period setting at max frame rate (about 30fps) is 993 lines. This means the maximum integration time setting at this frame rate is 992 lines or 32.5ms. See the ICD for details on setting exposure.

In external mode, the rising edge of the trigger-in pulse starts a rolling reset of the sensor lines and the falling edge of the trigger begins a rolling readout of the imager. Since the input trigger is asynchronous to the internal camera timing and exposure and readout occur with line time resolution the actual time the camera recognizes the input trigger rising and falling edges will have an uncertainty of one line time. Note that this is a rolling shutter, and thus while the exposure time of each line will be consistent; the exposure time of each line will not be simultaneous.

In external trigger mode the camera may be triggered at periodic rates of 30fps down to taking individual snapshots. As in internal trigger mode the exposure time can be anywhere from 1 line to the trigger period minus 1 line time. It should be noted however that practical max exposure time will be limited by sensor dark current.

When in external trigger mode, care must be taken to ensure that falling edges of the trigger never occur faster than the max frame rate of 30fps. Due to sensor operation details this can cause the sensor to get into an invalid state that can take several seconds to recover from.

In external trigger mode, the external trigger pulses can be supplied via the trigger-in pin of the trigger in/out connector or via the Camera Link CC1 line.

3.8 Flat Fielding (Non-Uniformity Correction)

Variations in the imager output, pixel-to-pixel within each color, are normalized to a common response curve using an offset non-uniformity correction (NUC) performed at the factory. The NUC correction is applied to both the digital and analog video outputs.

3.9 Digital and Analog Video Output Options

The Tau CNV provides both digital and analog video output. The digital output is a NUC corrected RGB video output and is available using the Parallel or Camera Link interface. The analog video has NUC, color, white balance and contrast corrections (as enabled) and is available in NTSC or PAL (future) formats on the Group Interface and on the Parallel Interface.

3.10 Small Space-Claim and Low Power Requirements

The Tau CNV is designed for OEM applications that require small space claim and low power. The Tau format provides a very compact camera by using high-density electronic circuitry and board-stacking topology. Low power is achieved through the balance of performance, the use of low power circuitry and high efficiency power management.

3.11 Effective Day and Night Color through built-in Filter Slider (Optional)

Although the camera uses a precision algorithm for color production, an infrared cut (IR Cut) filter, such as the BG38, should be used to obtain the best quality color. This is due to the physics of light energy. Infrared (IR) light passes through the red, green, and blue filters of the Bayer pattern equally well softening the colors by saturation. Through the use of a color daytime filter the colors are true throughout the day time performance. Filter adjustment to night time operation and back is automatic. With the use of the night time filter the near IR wavelengths are imaged, allowing enhanced nighttime viewing due to higher sensitivity but sacrificing true color production. For more mechanical detail on the day/night filter system see Figure 5. Use of an IR corrected lens is recommended to prevent apparent shifts in focus when the night time filter is in use.

4 Camera Specifications

4.1 Camera Specifications

Table 1: Tau CNV Camera Specifications [1]

Camera	Specification
Image Sensing	Color or Monochrome
Pixel Type	6.5um^2 5T Active Pixels
Resolution	1280 x 960 and 1280x720 (HD 720p)
Dynamic Range	84 dB [1]
Shutter Mode	Rolling Shutter
Read Noise	2 e- rms [1]
Frame Rate	30 FPS @ HD Resolution
Quantum Efficiency	>50% at 600nm
Image Lag	< 0.1%
Input / Output	**Specification**
Data Format	14/16-bit Camera Link 16-bit 3.3V LVCMOS Parallel NTSC Video
Trigger / Sync Connector	Camera Link CC1 or LVTTL Level
Control & Communications	Serial Commands
Communication Protocol	3.3V LVCMOS Parallel Camera Link USB RS-232 (future)
Trigger	**Specification**
Definitions	Serial Commands
Modes	Free Run (Internal)*, External Trigger *(with defined integration time)
External Trigger Source	Camera Link Trigger Input/Output Connector
Synchronization	Sync Output Pulse (Trigger Input/Output Connector)

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Features	Specification
Image Correction	Non-Uniformity Correction (NUC) Gamma Color Balance (color version only) Gain
Gain Control	Automatic (AGC) and Manual
AGC Region of Interest	Selectable
White Balance	Automatic and Manual (color version only)
Noise Filtering	Multi-level, Selectable
IR Cut Filter	Optional, Integrated Motorized Filter (color version only)
Mechanical	**Specification**
Lens Mount	M42 with C-mount or F-mount Adapter
Case Dimensions	48 x 49.4 x 64.5 mm
Case Material	Aluminum, Alodine, Gold Finish
Lens Mount Material	Aluminum, Anodized, Black Finish
Lens Mount Inserts	Steel, Stainless
Weight	< 175 grams
Environmental	**Specification**
Temperature, Full Performance	-20°C to +35°C
Temperature, Degraded Performance	+35°C to +50°C
Temperature, Storage	-40°C to +55°C
Humidity	95%, Non-Condensing
Power Requirements	**Specification**
Input Voltage	12 VDC ± 5%
Power Consumption	< 4W (typical)

Notes:

1. These are the specifications for camera performance at 20 °C. For camera performance specifications over the operating temperature range, please contact your FLIR representative.

4.2 Quantum Efficiency (QE) Response Curves

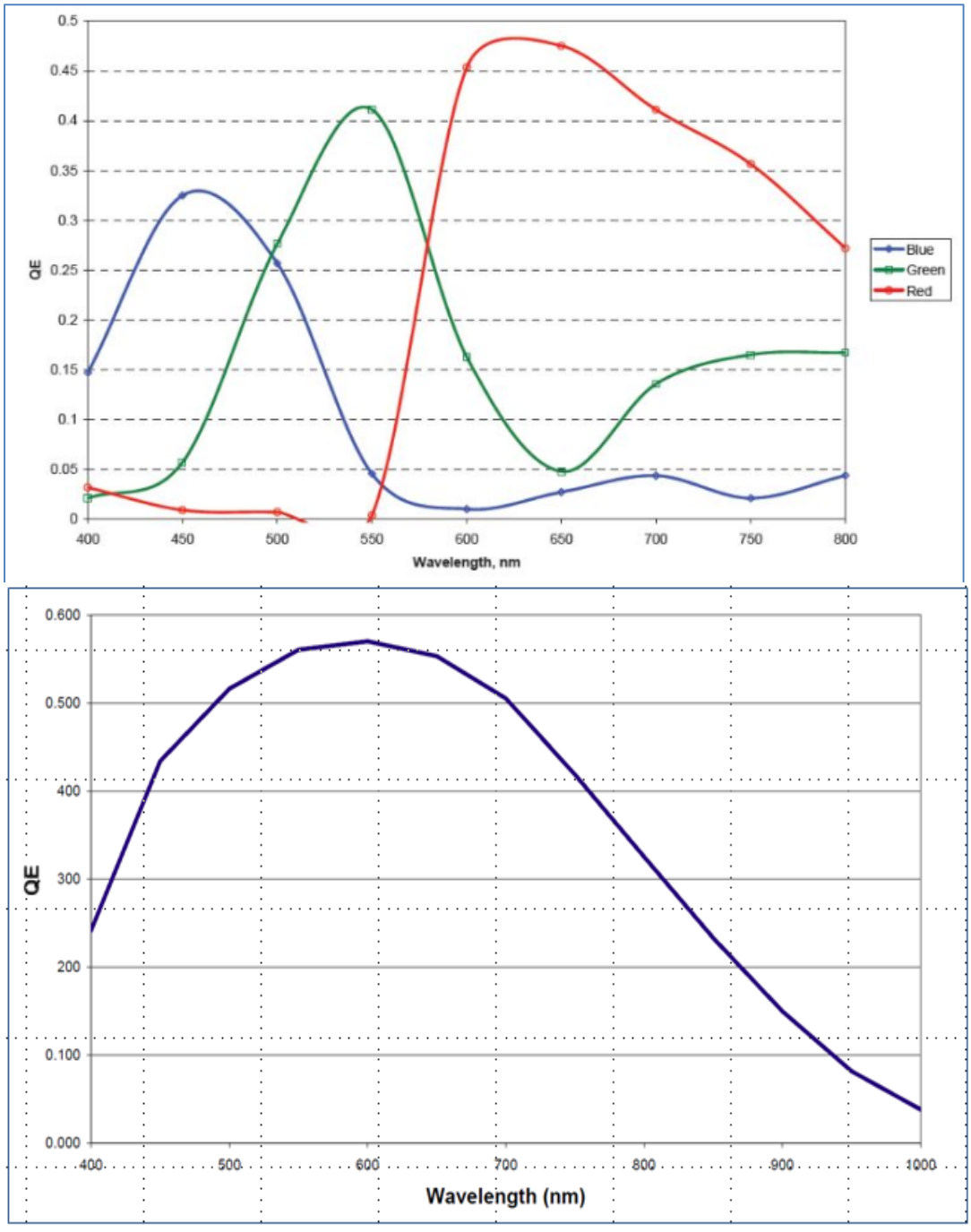

Figure 2: QE Response Curves for Color Camera and Monochrome Cameras

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5 Theory of Operation

5.1 Camera Layout

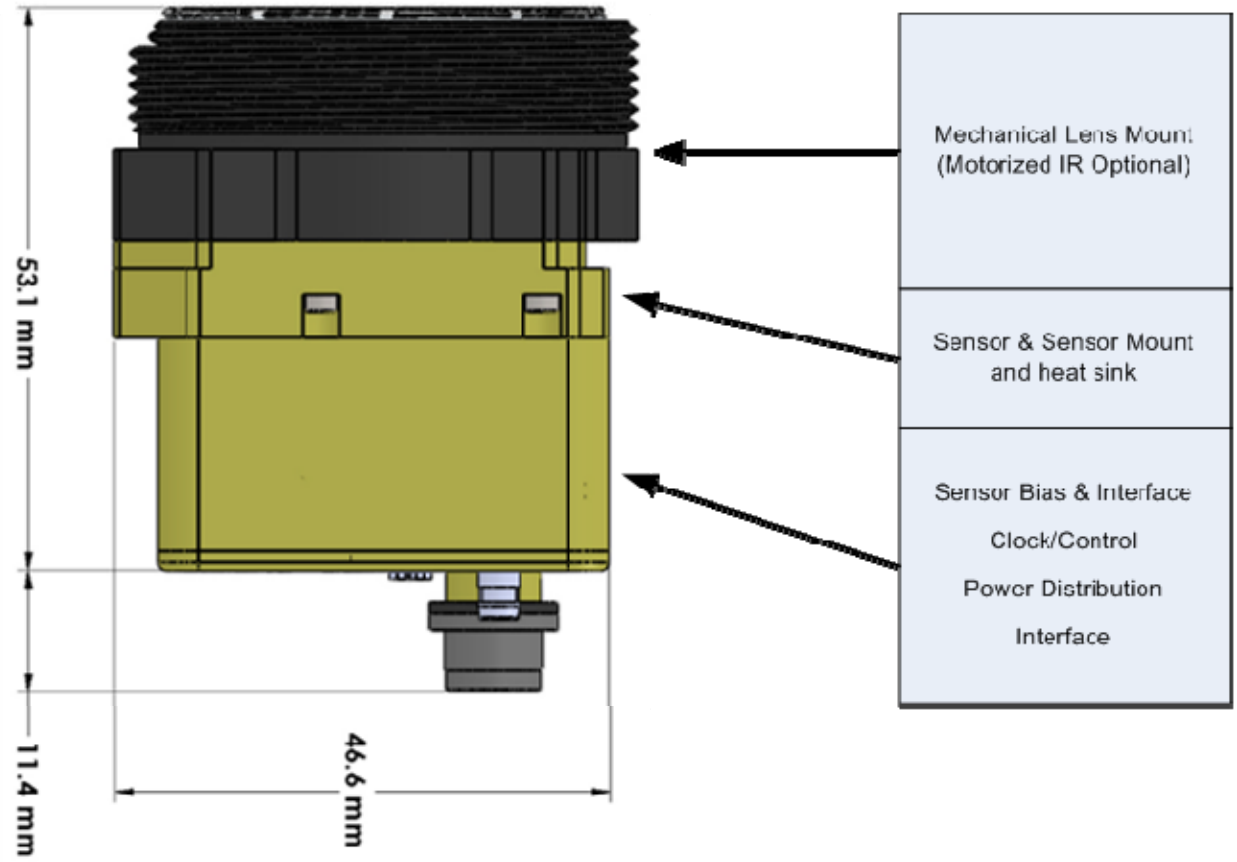

Figure 3: CNV Camera (not shown with optional motorized IR-cut Filter for color camera)

5.2 Lens Mount Assembly

The lens mount assembly is a mechanical interface that positions and aligns a C-mount, F-mount, or M42 mount lens to the camera focal plane. The lens mount assembly is an M42 mechanical mount that is properly aligned with the camera sensor mount via precision alignment pins. C-mount and F-mount lenses interface to the M42 mechanical mount using their associated adapter mechanisms.

For customers that have their own optics and mechanical mounting housings, the CNV camera can be used without the M42 lens mount assembly. In this case, the customer uses the sensor mounting plate precision alignment pins to align the CNV camera focal plane with the customer's optical assembly.

The M42 can be equipped with the optional motorized IR-cut filter for day and night imaging applications. The IR-cut filter is an integrated BG38 glass filter for day time color imaging and optical pass filter for low-light imaging applications. The filter is controlled manually using serial commands, or under automatic control for detected low-light conditions. The default operation is manual control.

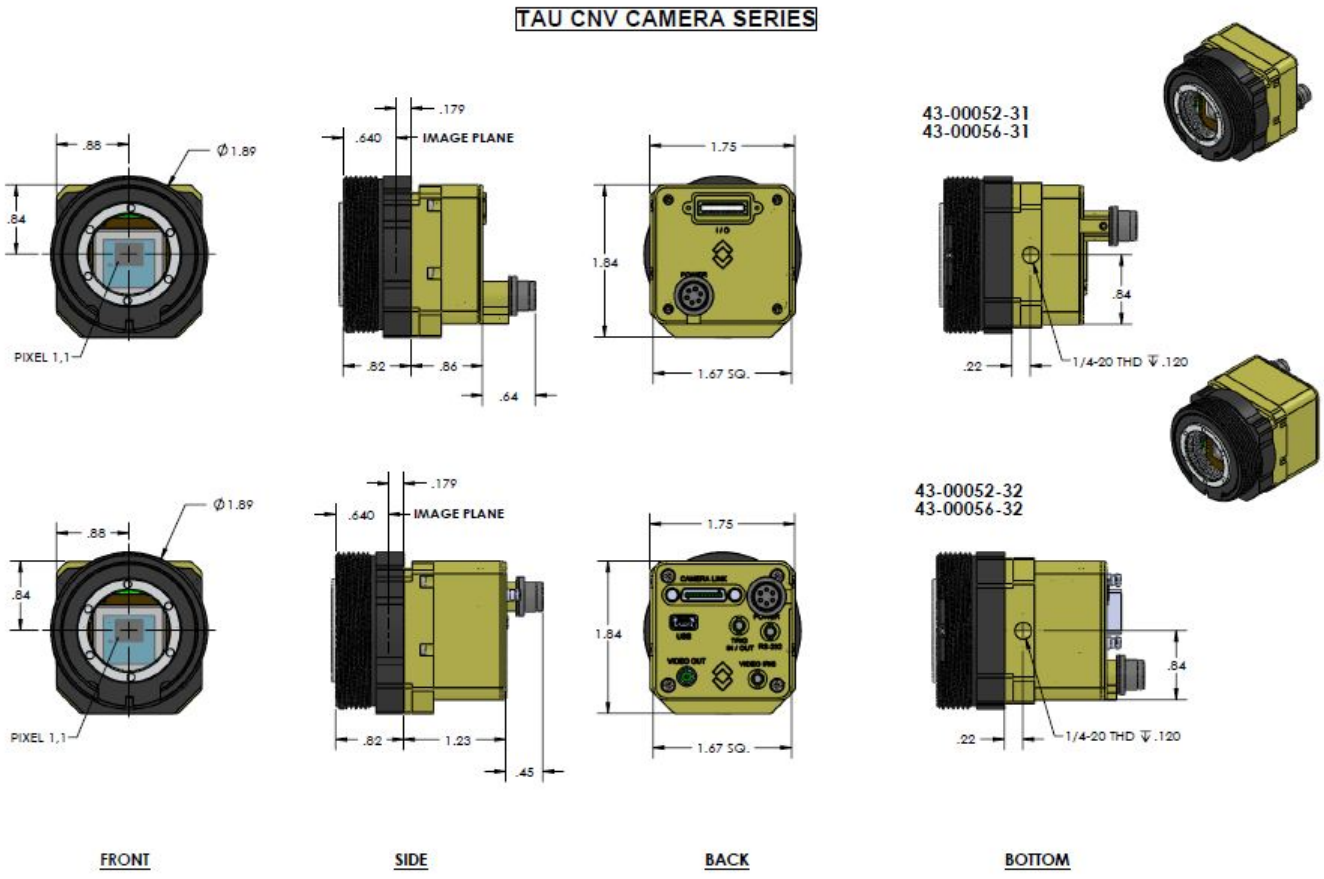

Figure 4: Tau CNV Camera with M42 Lens and C-Mount Adapter

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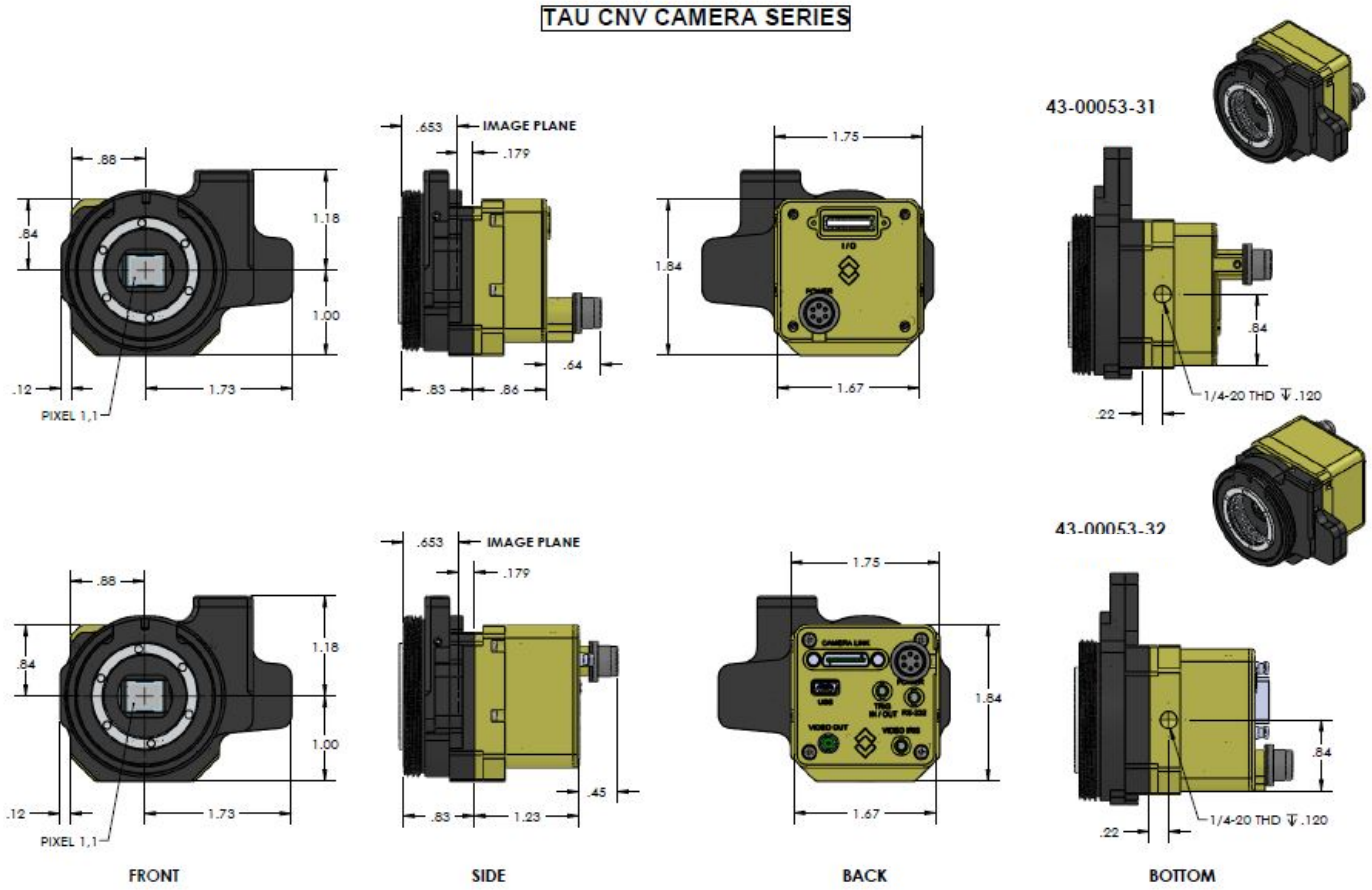

Figure 5: Tau CNV Camera with M42 Lens Mount, Integrated IR-Cut Filter Slider (color only), and C-Mount Adapter

5.3 Tau CNV CMOS Sensor

The FLIR AIS Tau CNV is based on a high dynamic range Scientific CMOS (sCMOS) imager technology. The sensor features a split readout scheme in which the top and bottom halves of the sensor are read out independently. Each column within each half of the sensor is equipped with dual column level amplifiers and dual analog-to-digital converters. This architecture was designed to minimize read noise and maximize dynamic range simultaneously. The dual column level amplifier/ADC pairs have independent gain settings, and the final image is reconstructed by combining pixel readings from both the high gain and low gain readout channels to achieve a wide intra-scene dynamic range from such a small pixel pitch. Micro-lenses are used to focus more of the incident light onto the exposed silicon and away from the transistors where it can be gathered improving the quantum efficiency (QE) of the sensor.

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Each pinned-photodiode pixel uses a 5-transistor ('5T' design), facilitating correlated double sampling (CDS) and a lateral anti-blooming drain. Using this architecture, non-linearity is less than 1%.

5.4 Sensor Mount and Heat Sink

The sensor mount is used to align the lens assemblies to the camera focal plane using precision alignment pins and to mount and heat-sink the camera to the customer's assembly. The camera sensor is mounted to the sensor mount plate. The sensor mount aligns the sensor to the precision alignment pins.

The sensor mount is also designed to be the mounting point for the camera to the customer's assembly. The sensor mount should be clamped into place with good thermal contact between the sensor mount plate and the customer's assembly. Care should be taken to maintain the case operating temperatures in accordance with the camera specifications.

Heavy optical assemblies (focal length greater than 75mm) or other assemblies should not use the lens mounting assembly without additional lens supports. The sensor mount also includes a tapped ¼-20 tripod adapter mounting hole, and the tripod adapter can be procured from FLIR.

See section 7 for the mechanical mounting information and section 8 for camera mounting & cooling information.

5.5 Camera Electronics

The camera electronics includes four major subassemblies:

- Sensor Bias and Interface
- Clock and Control Circuitry
- Power Conditioning and Distribution
- Camera Interface

5.5.1 Sensor Bias and Interface

The sensor bias and interface circuits are used to provide the necessary bias controls to the camera sensor, provide the necessary sensor timing signals, monitor sensor health and temperature, and to get the raw sensor data from the sensor to the back-end electronics for image processing.

5.5.2 Clock and Control Circuitry

All camera control and image processing takes place in the clock and control circuitry. This circuitry contains the FPGA that performs timing and control of the imaging sensor, image processing functions, and memory for storing camera specific information and to support image processing.

5.5.3 Power Conditioning and Distribution

The power conditioning and distribution circuitry converts the single power input to a variety of internal voltages to support image sensor biasing, logic biasing and external camera interface requirements. This circuitry may also perform thermal electric cooler (TEC) control if your camera is equipped.

5.5.4 Camera Interface

The camera interface is used to provide external connections and formatting for camera control, video output, and camera synchronization. The interface control document (ICD) covers both the pin-outs and camera commands, and should be used as the reference document for interfacing to the camera.

The Tau CNV has two interface types: (1) The parallel interface; and (2) the group interface. The parallel interface is a 3.3V Low Voltage CMOS (LVCMOS) interface connector that includes camera control, digital video output, analog video output, and camera synchronization signals. The group interface is a cluster of connectors including Camera Link interface for digital control and digital video, USB control, analog video, trigger in/out, RS232 control (future), and video IRIS (future). See section 6 for a complete description of the camera interface.

6 Camera Interfacing

The Tau CNV camera parameters are controlled and status monitored using serial communication via an LVDS parallel, USB, or Camera Link connection. Digital video data and triggering are also available over the LVDS parallel and Camera Link connection. Non-digital NTSC analog video is also available.

Two configurations are available. The LVDS parallel data communication interface and the group interface which supports Camera Link data communication, analog output, trigger in/out, RS232 control (future), and USB control.

For greater detail on the camera interface specifications, please see the Tau CNV interface control document.

6.1 LVDS Parallel Data Communication

The basic camera configuration uses a 50-pin connector (Hirose DF12-50DS-0.5V (86)) for the parallel data interface. A diagram of the back plate of the camera showing the various I/O connectors is shown below:

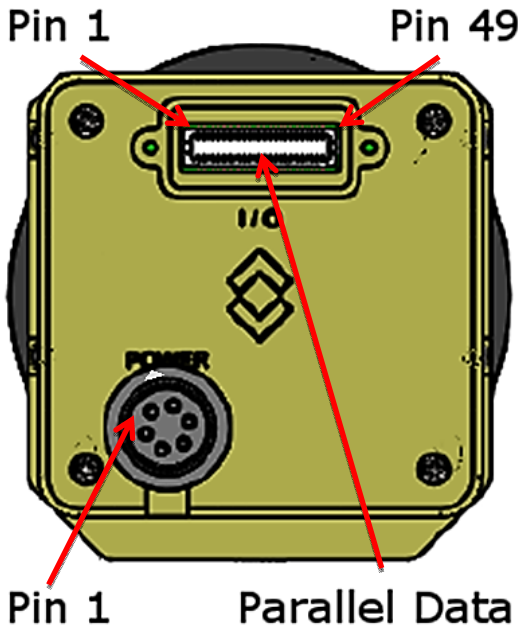

Figure 6: Camera Parallel Interface Back Plate Diagram.

6.1.1 Power Connector

The input power connector is a Hirose HR30-6P-6S (71).

Table 2: Parallel Interface, Power Connector

Pin #	Signal Type
1	Signal Ground
2	Signal Ground
3	No Connection
4	+12 VDC
5	+12 VDC
6	No Connection

6.1.2 Parallel Data Connector

The Tau CNV camera (with LVDS parallel configuration) can provide 14-bit or 16-bit CMOS data with sync signals as well as analog video output simultaneously.

Table 3: Parallel Interface Connector Pin Out

Pin #	Function	I/0	Signal Type	Description
1	RS232_TX	Out	3.3V LVCMOS	Serial to Controller
2	RS232_RX	In	3.3V LVCMOS	Serial to Camera
3	LVAL	Out	3.3V LVCMOS	Line Valid
4	FVAL	Out	3.3V LVCMOS	Frame Valid
5,6	Gnd	-	Ground	
7	LVDS_RX0_P	In	LVDS	Board Rev 0
8	LVDS_RX0_N	In	LVDS	Board Rev 1
9	LVDS_Clk_P	Out	LVDS	LVDS Clock +
10	LVDS_CLK_N	Out	LVDS	Data 14
11	LVDS_Sync_P	In	LVDS	Board Rev 2
12	LVDS_Sync_N	Out	LVDS	LVDS Sync –
13	LVDS_Data0_P	In	LVDS	CC1 Trigger Input
14	LVDS_Data0_N	Out	LVDS	Data 15
15	LVDS_Data1_P	Out	LVDS	LVDS Data 1 +
16	LVDS_Data1_N	Out	LVDS	LVDS Data 1 -
17,18	Gnd	-	Ground	
19	DISCRETE0	I/O	3.3V LVCMOS	Programmable I/O
20	CMOS_Data13	Out	3.3V LVCMOS	Data 13

21	EXTERNAL_SYNC	In	3.3V LVCMOS	External Trigger Input
22	CMOS_DATA12	Out	3.3V LVCMOS	Data 12
23	CMOS_DATA11	Out	3.3V LVCMOS	Data 11
24	CMOS_DATA10	Out	3.3V LVCMOS	Data 10
25	CMOS_DATA9	Out	3.3V LVCMOS	Data 9
26	CMOS_DATA8	Out	3.3V LVCMOS	Data 8
27,28	Gnd	-	Ground	
29	CMOS/BT656_DATA7	Out	3.3V LVCMOS	Data 7
30	CMOS/BT656_DATA6	Out	3.3V LVCMOS	Data 6
31	CMOS/BT656_DATA5	Out	3.3V LVCMOS	Data 5
32	CMOS/BT656_DATA4	Out	3.3V LVCMOS	Data 4
33	CMOS/BT656_DATA3	Out	3.3V LVCMOS	Data 3
34	CMOS/BT656_DATA2	Out	3.3V LVCMOS	Data 2
35	CMOS/BT656_DATA1	Out	3.3V LVCMOS	Data 1
36	CMOS/BT656_DATA0	Out	3.3V LVCMOS	Data 0
37,38	Gnd		Ground	
39	CMOS/BT656_CLK	Out	3.3V LVCMOS	CMOS Clock
40	-	-	Unused	
41,42	Gnd		Ground	
43	VIDEO_OUT	Out	Analog 75Ohm 1Vpp	Analog Video
44,45	Gnd		Ground	
46	3V3	Out	Power	3.3 Volt Supply for Adaptor Boards
47,49	Gnd		Ground	
48,50	-	-	Unused	

6.2 Group Interface

The Tau CNV group interface supports: (1) Camera Link control and digital video output; (2) USB / RS232 (future) camera control and analog video output; (3) trigger input/output; and (4) video IRIS (future).

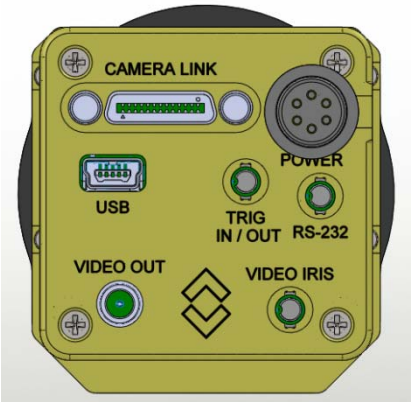

Figure 7: Group Interface Back Panel View

6.2.1 Group Interface Default Settings

The table below shows the group output default settings

Table 4: Group Interface Default Configuration

Function	Default Condition
Trig IN/OUT	Not Active
Trigger Mode	Free Running
Video Output	Active, NTSC Analog
Camera Link	Enabled / Active
USB	Enabled / Active
RS232 (future, do not use)	Disabled (all modes)
VIDEO IRIS (future, do not use)	Disabled (all modes)

6.2.2 Power Connector

The input power connector is a Hirose HR30-6P- 6S (71).

Table 5: Parallel Interface, Power Connector

Pin #	Signal Type
1	Signal Ground
2	Signal Ground
3	No Connection
4	+12 VDC
5	+12 VDC
6	No Connection

6.2.3 Camera Link

The Camera Link interface connector is labeled on the group interface back panel (see Figure 7: Group Interface Back Panel View). The Camera Link connector is a 3M 12226-1150-00FR Shrunk Delta Ribbon (SDR-26) female connector. The connector orientation is shown in figure 8 and the pin-out is shown in table 6. Since most frame grabbers use an MDR-26 connector, the user may need a Camera Link cable that includes a male SDR-26 connector on the camera end and an MDR-26 connector on the frame grabber end.

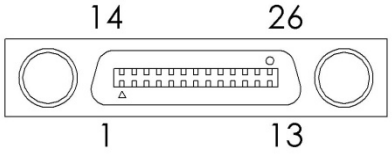

Figure 8: Camera Link SDR-26 diagram

Table 6: Camera Link SDR-26 Connector Pin Assignment

Pin #	Function	I/0	Signal Type	Description
1	Inner Shield			Signal Ground
2	X0-	Out	LVDS	Data 0 -
3	X1-	Out	LVDS	Data 1 -
4	X2-	Out	LVDS	Data 2 -
5	Xclk-	Out	LVDS	Clock -
6	X3-	Out	LVDS	Data 3 -
7	SerTC+	In	LVDS	Serial Data to Camera +
8	SerTFG-	Out	LVDS	Serial Data from Camera -
9	CC1-	In	LVDS	Camera Control 1 -
10,11,12			Unused	
13,14	Inner Shield			Signal Ground
15	X0+	Out	LVDS	Data 0 +
16	X1+	Out	LVDS	Data 1 +
17	X2+	Out	LVDS	Data 2 +
18	Xclk+	Out	LVDS	Clock +
19	X3+	Out	LVDS	Data 3 +
20	SerTC-	In	LVDS	Serial Data to Camera -
21	SerTFG+	Out	LVDS	Serial Data from Camera
22	CC1+	In	LVDS	Camera Control 1 +
23,24,25			Unused	
26	Inner Shield			Signal Ground

A complete description of the Camera Link standard can be purchased from the AIA organization at http://www.machinevisiononline.org/store/category.cfm?category_id=76. The FLIR AIS Tau CNV camera provides a Frame Valid (FVAL) pulse which goes high during the reading out of the frame and goes low after reading out the complete frame. The camera provides a Line Valid (LVAL) pulse which goes high while each line of pixel data is read out and goes low once the line has been read out. The data is converted inside the camera to 14 or 16 bit digital. The 14 or 16 bits of data per pixel are sent out over the appropriate data lines according to the Camera Link base configuration standard. The default mode is 16 bits output. Most frame grabbers include a method to capture the full image in their frame store from this data format. A list of frame grabbers that have been used with this camera can be obtained by contacting supportais@flir.com.

6.2.4 Analog Video Output and Serial Interface (default configuration)

The default video output is the analog output and is labeled as "Video Output" on the group interface back panel (see Figure 7: Group Interface Back Panel View). The video output is NTSC and PAL (future) and the connector is a Samtec MCX7-J-P-H-ST-TH1. When using the video output, camera control and status uses the USB or RS232 (future) serial interface connector, labeled "USB" and "RS232" on the group interface back panel.

The USB interface is the industry standard mini-USB with the connections as shown in Table 7

Note: the camera is NOT powered through the USB connector.

Table 7: USB Mini-B Interface

Pin #	Function	Description
1	VCC	+5VDC
2	D-	Data -
3	D+	Data +
4	ID	A/B Distinction
5	GND	Signal Ground

6.2.5 Trigger In/Out

The Trigger IO connector is a Hirose SR38-4R-3S(71) and is labeled "TRIG IN/OUT on the rear of the camera.

Table 8: TRIG IN/OUT Interface

Pin #	Function	Description
1	TRIGGER IN	Logic Level
2	TRIGGER OUT	Logic Level
3	GND	Signal Ground

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6.2.6 Trigger In Mode

The Tau CNV has two trigger modes, internal self-triggered "free-run" mode and external trigger mode.

External trigger mode is only through the parallel interface connector, Camera Link interface connector, and the trig IN/OUT, as a Trig IN function, when using the USB/RS232 serial interfaces.

- ***Free Run Mode*** – The camera operates at 30FPS based upon an internal, free-running clock.

- ***External Trigger Mode –*** The camera can be synchronized with external events for capturing image data. The integration begins when the external trigger goes high, and readout begins when the external trigger goes low. The external trigger may be provided to the camera via the CC1 signal of the Camera Link interface or via the "Trigger In" pin of the TRIG IN/OUT connector on the rear of the camera. **NOTE**: For proper operation, external trigger falling edges must never occur at a rate faster than the minimum frame period (approximately 33ms).

These trigger modes are fully described in the Tau CNV interface control document (ICD). Contact your local sales or technical support for details.

6.2.7 Trigger Out Mode

The camera provides a trigger output signal on the "Trigger Out" pin of the TRIG IN/OUT connector on the rear of the camera. This signal maintains a fixed timing relationship with the camera exposure and can be used to tune external events to occur during the camera integration time.

6.2.8 Video IRIS (future)

The video IRIS connector is currently not enabled and reserved for future applications. Do not use this connector.

7 Mechanical Detail

7.1 Housing & Materials

The Tau CNV camera housing encompasses front lens mount, sensor mount, and rear panel. This housing performs the cooling and heat dissipation, mechanical mounting, and contains the rear panel electrical markings and connections. The front lens mount material is anodized aluminum with a black finish. The C-mount lens adapter is nickel plated aluminum. The F-mount adapter is black anodized

aluminum. The case is Alodine treated aluminum with a gold finish and is electrically conductive to reduce susceptibility to, and emission of EMI. The case back panel uses a laser etch process to mark all connectors.

7.2 Dimensions

The Tau CNV is a small space-claim camera measuring only 48x49.4x64.5mm (without optics), which makes the camera perfect for space limited OEM applications. See figure 9.

The C-mount adapter is fully adjustable for back focus to support a wide variety of C-mount lenses.

The lens mount can be removed for customer specific optical packages; use the dimensions provided in the Tau CNV sensor mounting plate. Contact your local sales representative for this option.

Dimensions are given in millimeters.

7.3 Lens Mounting and Back Focus Adjustment

The FLIR AIS Tau CNV camera has two options for lens mounting: The M42/C-mount and the M42/F-mount. After mounting the lens into the C-mount lens adapter, the camera must be back focus adjusted and locked prior to use.

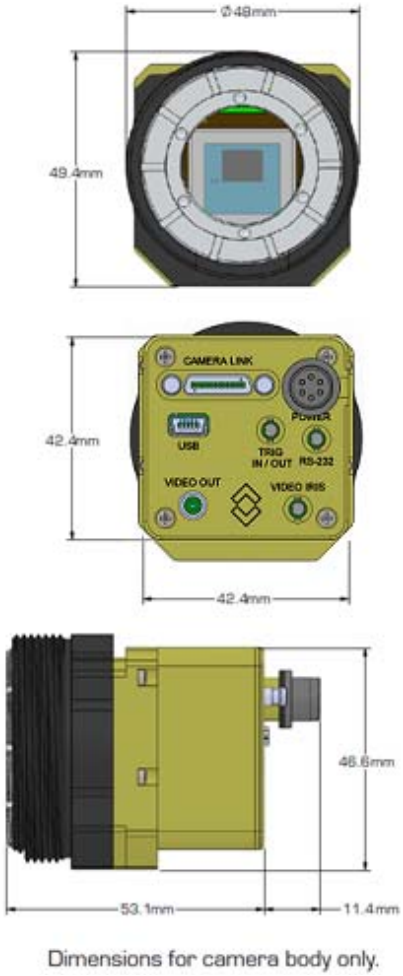

Figure 9: Dimensions

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8 Camera Mounting & Cooling

The Tau CNV operating temperature is specified as a case temperature range of -20°C to +50°C with degraded performance in the +35°C to +50°C The Tau CNV sensor mount is used to both mount the camera to the user's assembly, and to conduct heat away from the camera electronics. The camera makes automatic and continuous adjustment to compensate for changes in case temperature; however, to maximize camera performance, the user should avoid rapid changes in the camera case temperature by using a large thermal mass on which to mount the camera and with continuous controlled temperature air flow over the camera.

8.1 ¼ - 20 Mounting Hole

The ¼ - 20 mounting hole is available for camera mounting but is not designed to be used with a standard tripod mount. A standard tripod mount requires a deeper mounting hole than is available with the small CNV camera size. Please note that these holes are electrically connected to chassis ground. The ¼-20 mounting hole is also a convenient heat sink attachment point. In addition, the other 3 sides of the sensor mount are good surfaces for heat sinking purposes.

8.2 Important Mounting Requirements

For best performance from your TAU CNV camera the camera must be properly mounted to a heat conducting surface. The camera will typically dissipate 4W and must be properly secured to a heat conducting surface using the available ¼-20 mounting hole or customer provided custom clamp to the metal structure containing the ¼-20 mounting hole

9 Command and Control of the Camera

Camera control can be accomplished either through the Camera Link interface or through the camera's USB interface using FLIR's utility program "Universal Camera Controller". Alternatively, by installing a USB to COM port-bridge the user can pass serial commands or read camera status directly from a user's application program using the defined protocol and command set. To get more information about the command structure and integrating it into your application contact FLIR tech support for a complete Interface Control Document "ICD" (10-70044-01-A1) document.

9.1 FLIR AIS' Camera Control Utility

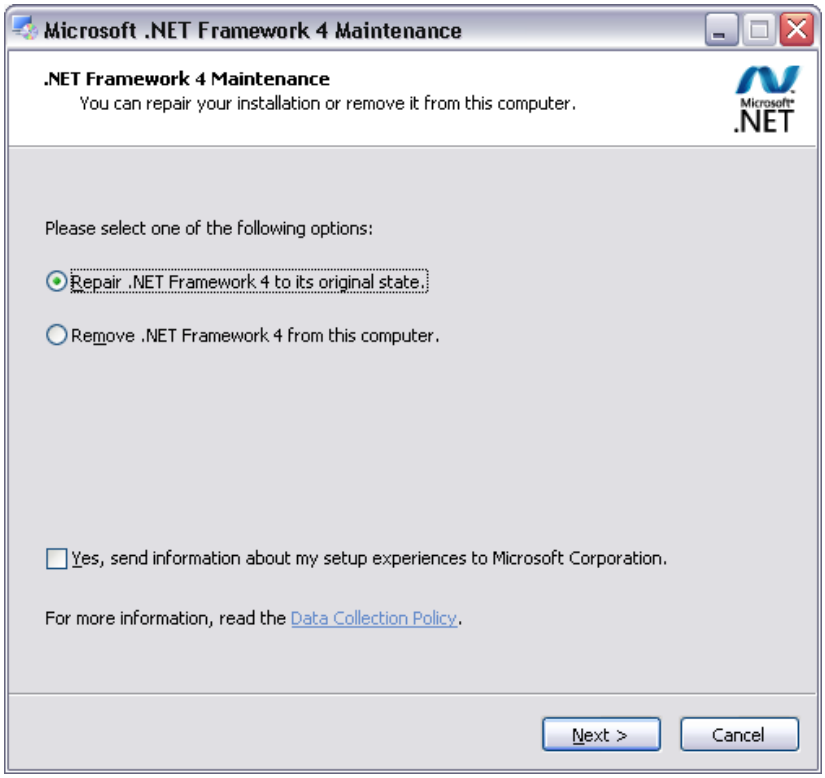
FLIR AIS also provides a utility program which runs on a PC with Microsoft Windows XP® or Windows 7 operating system using a standard PC serial COM port, USB port or a Camera Link compatible frame grabber which enables a serial COM port. With one of these connections cabled to the Tau CNV camera, the camera controller GUI can be used to control operating modes and gather status. Most of the user programmable functions that can be set and read by serial commands may also be set and read by using the Universal Camera Controller.

9.1.1 Installation

On the installation media (CD or USB flash drive) are three files: one is the installer for Universal Camera Controller, one is the USB serial bridge driver installer (required to communicate with the camera using its USB connection), and one is the installer for Microsoft .Net Framework 4 (the runtime environment in which UCC runs and is required). Install Microsoft .Net Framework first, followed by the USB serial bridge driver (if needed), and then UCC.

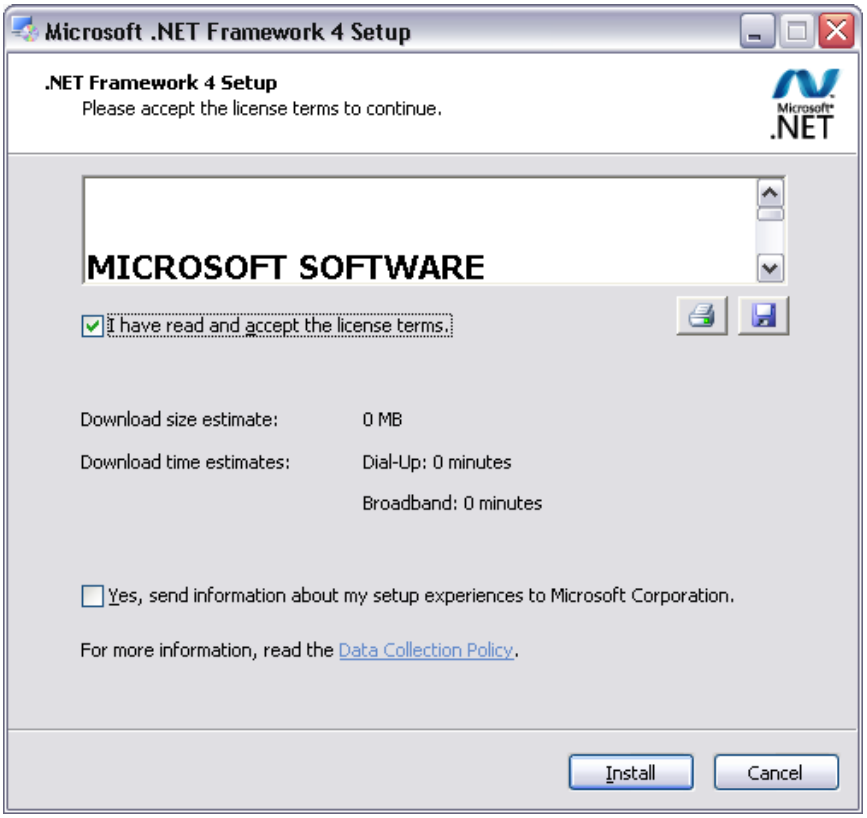
Microsoft .Net Framework 4

To install .Net Framework, find the file, dotNetFx40_Full_x86_x64.exe, on the included USB flash drive or CD. Double-click the file. If .Net Framework 4 is already installed, the following window (or one similar) will appear.

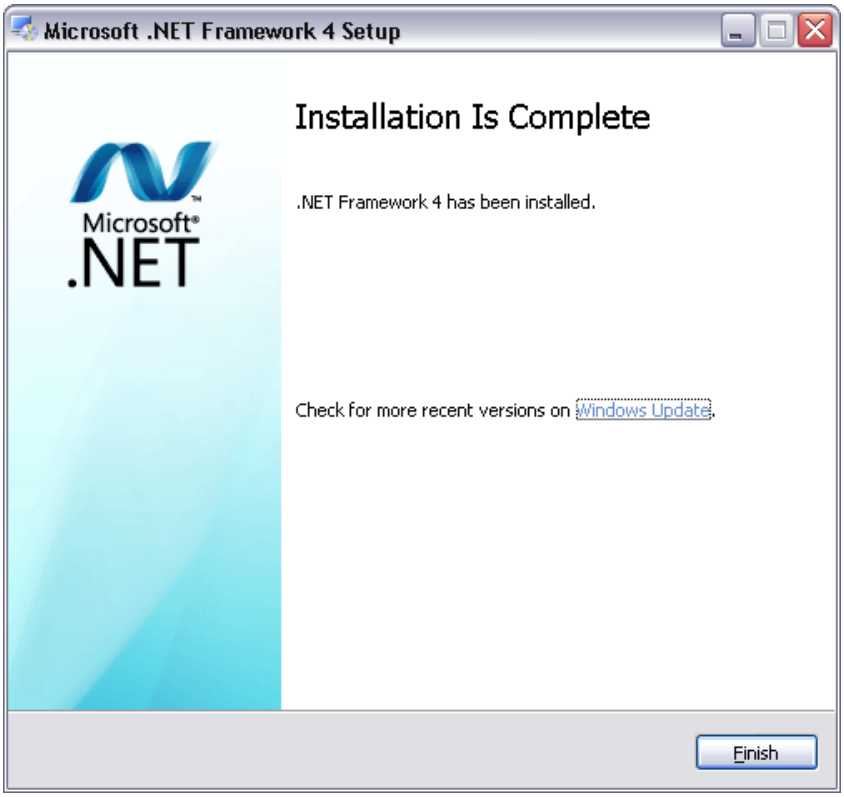

Microsoft .NET Framework 4 Maintenance
.NET Framework 4 Maintenance
You can repair your installation or remove it from this computer.
Please select one of the following options:
Repair .NET Framework 4 to its original state.
Remove .NET Framework 4 from this computer.
Yes, send information about my setup experiences to Microsoft Corporation.
For more information, read the Data Collection Policy.
Next >
Cancel

In this case, click “Cancel” and proceed to the section on installing the USB serial bridge driver (or directly to the section on installing UCC if you will not be communicating with the camera through its USB connection).

If .Net Framework 4 is not installed, the following window will appear:


Microsoft .NET Framework 4 Setup
.NET Framework 4 Setup
Please accept the license terms to continue.
MICROSOFT SOFTWARE
I have read and accept the license terms.
Download size estimate:
0 MB
Download time estimates:
Dial-Up: 0 minutes
Broadband: 0 minutes
Yes, send information about my setup experiences to Microsoft Corporation.
For more information, read the Data Collection Policy.
Install
Cancel

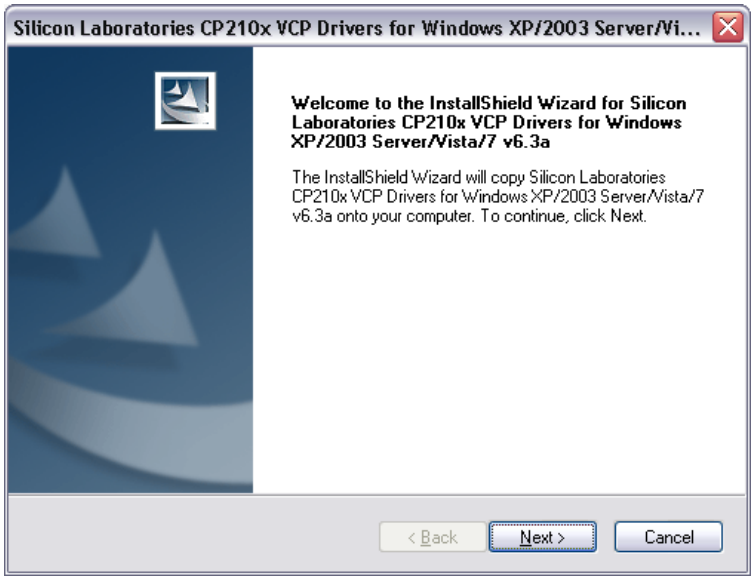
Check "I have read and accept the license terms," and click "Install." The following window will appear when installation is complete:


Microsoft .NET Framework 4 Setup
Installation Is Complete
.NET Framework 4 has been installed.
Check for more recent versions on Windows Update.
Finish

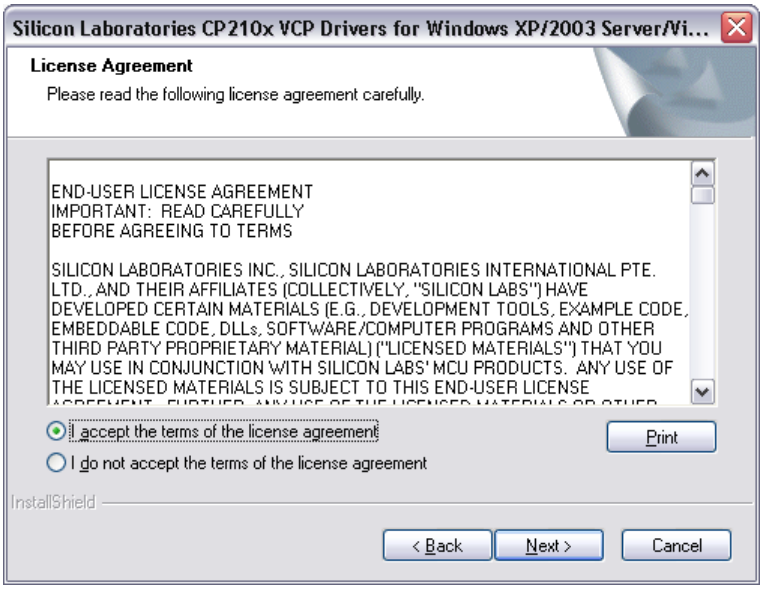
Click “Finish.”

USB Serial Bridge Driver

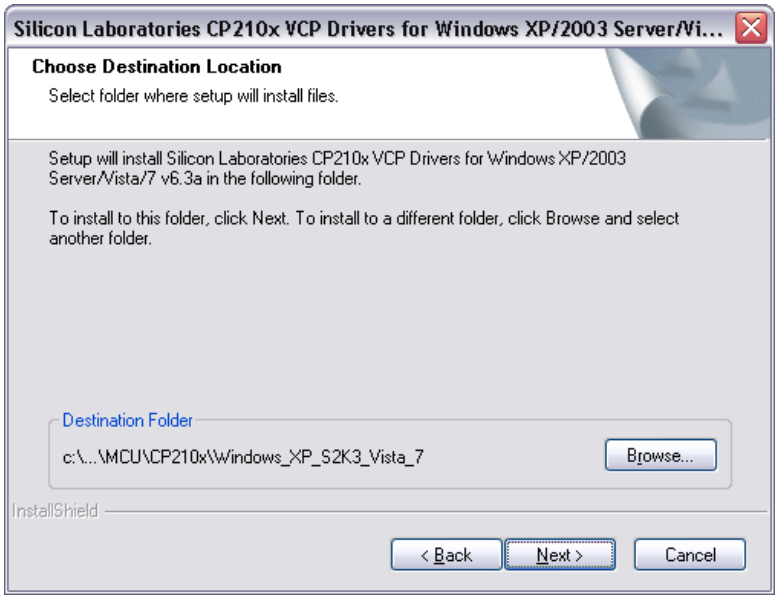
To install the USB serial bridge driver, find the file, CP210x_VCP_Win_XP_S2K3_Vista_7.exe, on the included USB flash drive or CD. Double click the file. The following window will appear:


Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vi...
Welcome to the InstallShield Wizard for Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vista/7 v6.3a
The InstallShield Wizard will copy Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vista/7 v6.3a onto your computer. To continue, click Next.
< Back
Next >
Cancel

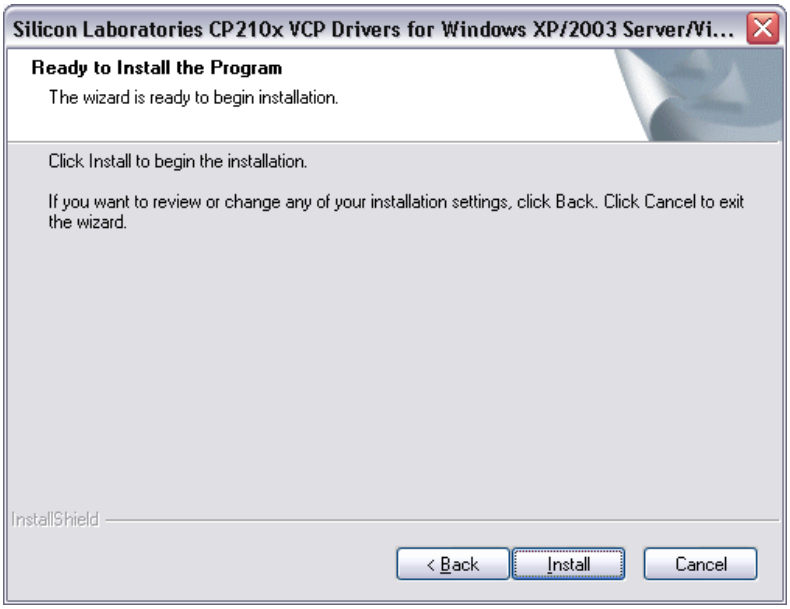
Click "Next."


Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vi...
License Agreement
Please read the following license agreement carefully.
END-USER LICENSE AGREEMENT
IMPORTANT: READ CAREFULLY
BEFORE AGREEING TO TERMS
SILICON LABORATORIES INC., SILICON LABORATORIES INTERNATIONAL PTE. LTD., AND THEIR AFFILIATES (COLLECTIVELY, "SILICON LABS") HAVE DEVELOPED CERTAIN MATERIALS (E.G., DEVELOPMENT TOOLS, EXAMPLE CODE, EMBEDDABLE CODE, DLLs, SOFTWARE/COMPUTER PROGRAMS AND OTHER THIRD PARTY PROPRIETARY MATERIAL) ("LICENSED MATERIALS") THAT YOU MAY USE IN CONJUNCTION WITH SILICON LABS' MCU PRODUCTS. ANY USE OF THE LICENSED MATERIALS IS SUBJECT TO THIS END-USER LICENSE
I accept the terms of the license agreement
I do not accept the terms of the license agreement
Print
InstallShield
< Back
Next >
Cancel

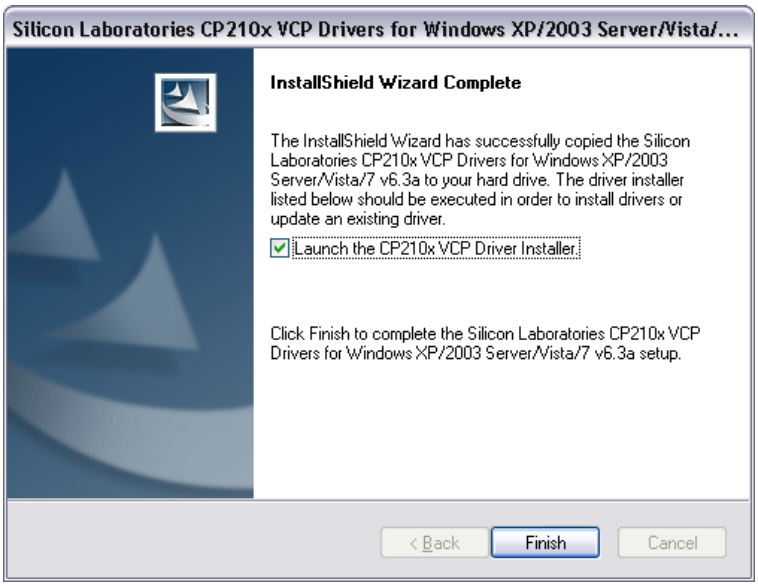
Select "I accept the terms of the license agreement," and click "Next."


Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vi...
Choose Destination Location
Select folder where setup will install files.
Setup will install Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vista/7 v6.3a in the following folder.
To install to this folder, click Next. To install to a different folder, click Browse and select another folder.
Destination Folder
c:\...\MCU\CP210x\Windows_XP_S2K3_Vista_7
Browse...
InstallShield
< Back
Next >
Cancel

Click “Next.”

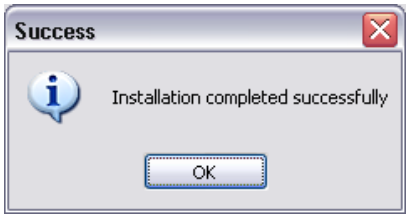

Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vi...
Ready to Install the Program
The wizard is ready to begin installation.
Click Install to begin the installation.
If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.
InstallShield
< Back
Install
Cancel

Click “Install.”


Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vista/...
InstallShield Wizard Complete
The InstallShield Wizard has successfully copied the Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vista/7 v6.3a to your hard drive. The driver installer listed below should be executed in order to install drivers or update an existing driver.
Launch the CP210x VCP Driver Installer
Click Finish to complete the Silicon Laboratories CP210x VCP Drivers for Windows XP/2003 Server/Vista/7 v6.3a setup.
< Back
Finish
Cancel

Make sure "Launch the CP210x VCP Driver Installer" is checked, and click "Finish." The following window will appear:

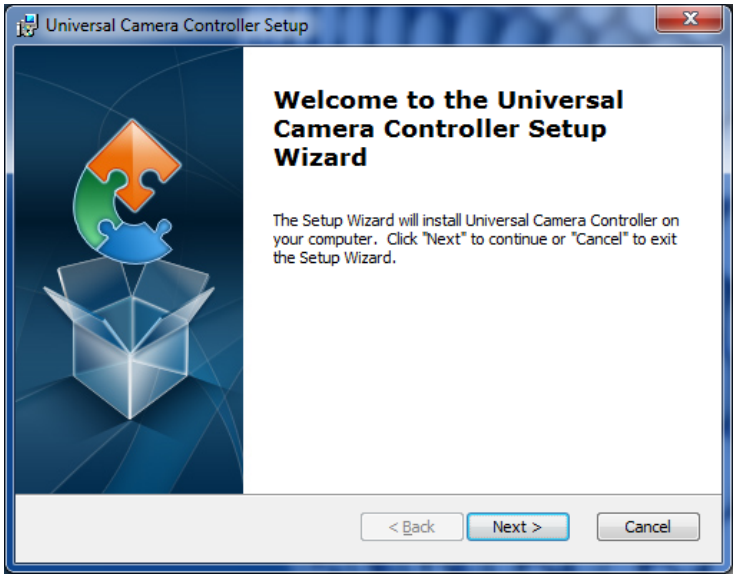
Click "Install." Wait until the following window appears:



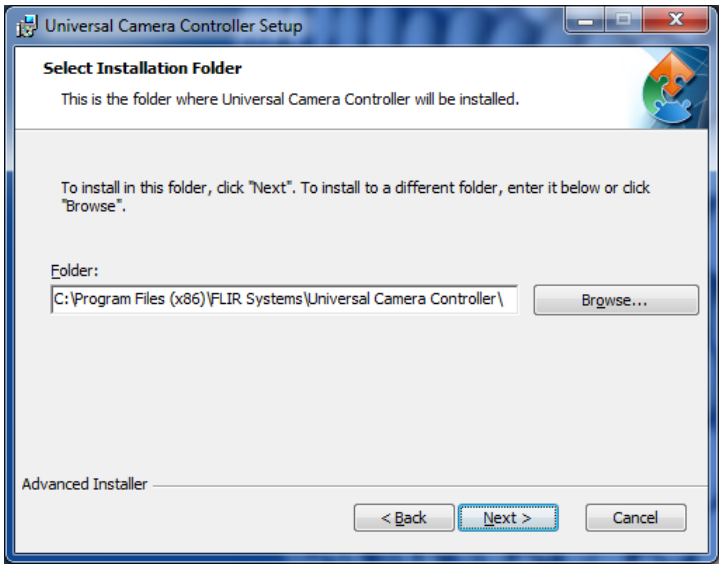
Click "OK."

Universal Camera Controller

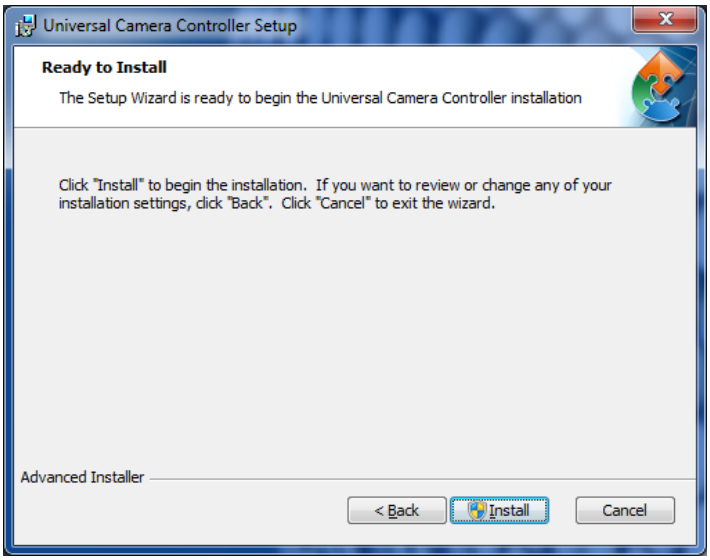
To install UCC, find the Universal Camera Controller Setup.msi file located on the included USB flash drive or CD, double click it, and follow the prompts:


Universal Camera Controller Setup
Welcome to the Universal Camera Controller Setup Wizard
The Setup Wizard will install Universal Camera Controller on your computer. Click "Next" to continue or "Cancel" to exit the Setup Wizard.
< Back
Next >
Cancel

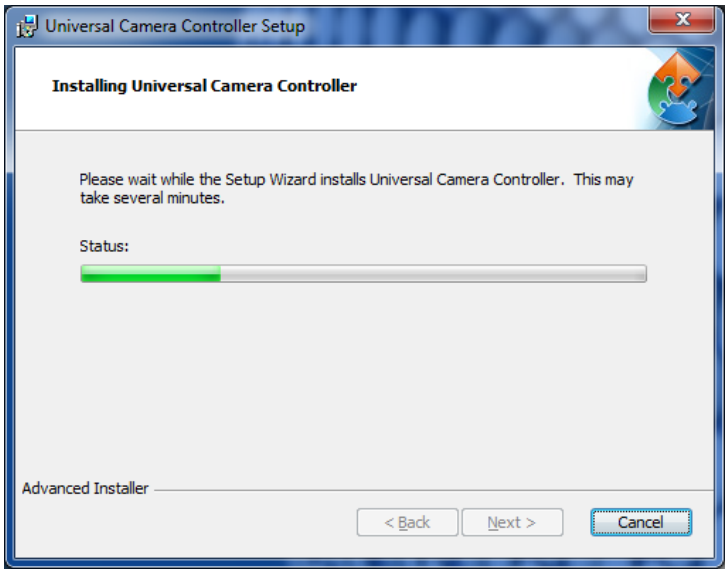
Click "Next"


Universal Camera Controller Setup
Select Installation Folder
This is the folder where Universal Camera Controller will be installed.
To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".
Folder:
C:\Program Files (x86)\FLIR Systems\Universal Camera Controller\
Browse...
Advanced Installer
< Back
Next >
Cancel

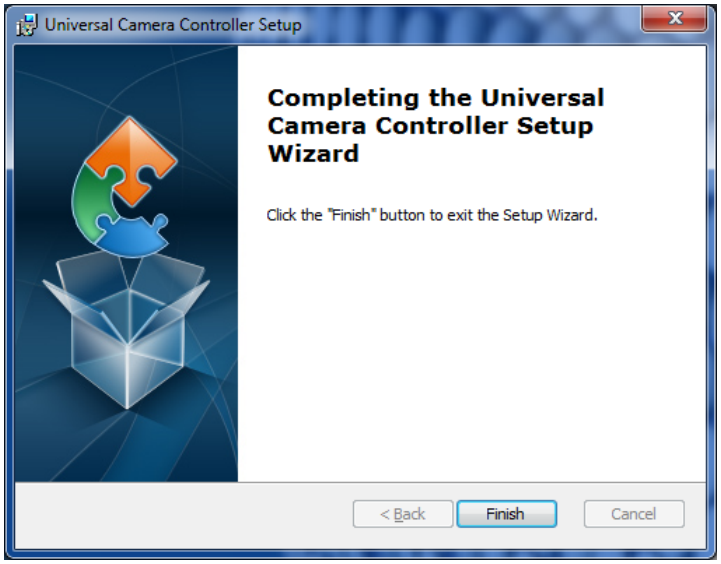
Choose the location to install the program. In most cases you should be able to select the default location. Click "Next.".


Universal Camera Controller Setup
Ready to Install
The Setup Wizard is ready to begin the Universal Camera Controller installation
Click "Install" to begin the installation. If you want to review or change any of your installation settings, click "Back". Click "Cancel" to exit the wizard.
Advanced Installer
< Back
Install
Cancel

Click “Install.”


Universal Camera Controller Setup
Installing Universal Camera Controller
Please wait while the Setup Wizard installs Universal Camera Controller. This may take several minutes.
Status:
Advanced Installer
< Back
Next >
Cancel

The install should take a few moments. When complete, the following window will appear:

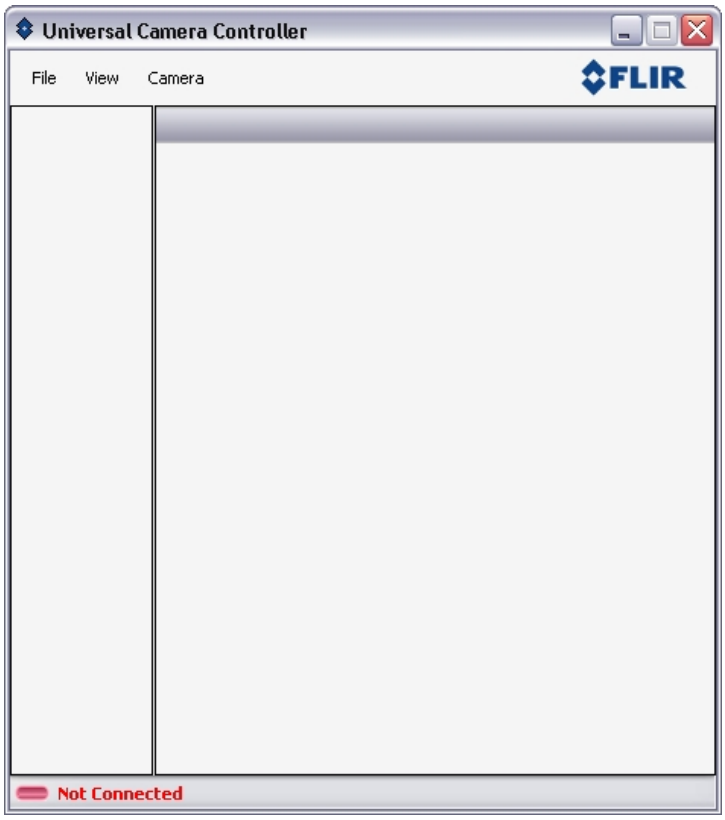

Universal Camera Controller Setup
Completing the Universal Camera Controller Setup Wizard
Click the "Finish" button to exit the Setup Wizard.
< Back
Finish
Cancel

The program installation is complete. Click “Finish” to exit setup. UCC is now installed and ready to use. See below for details on operating the software.

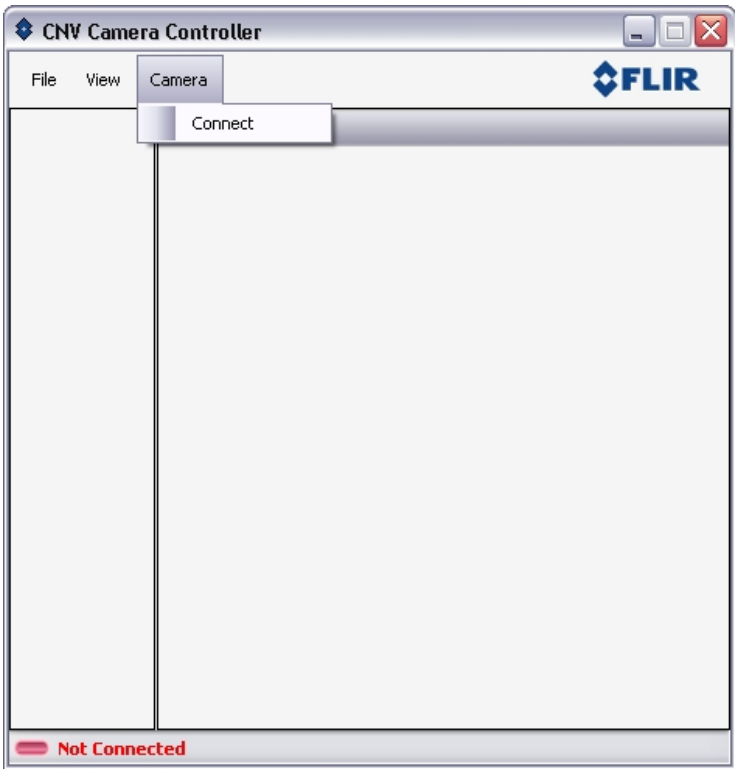
9.1.2 Camera Connection Screen

Note: At all times make sure the camera is connected and powered on BEFORE starting the Camera Controller GUI. This will make sure that the communication port is properly opened.

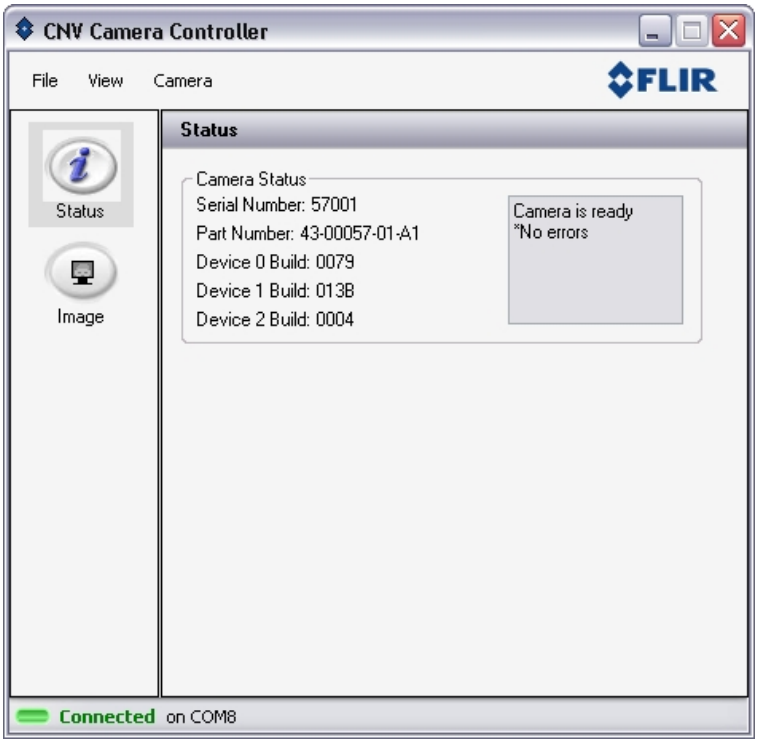
When Camera Controller GUI is first executed, the "Connections" screen will come up as shown below.



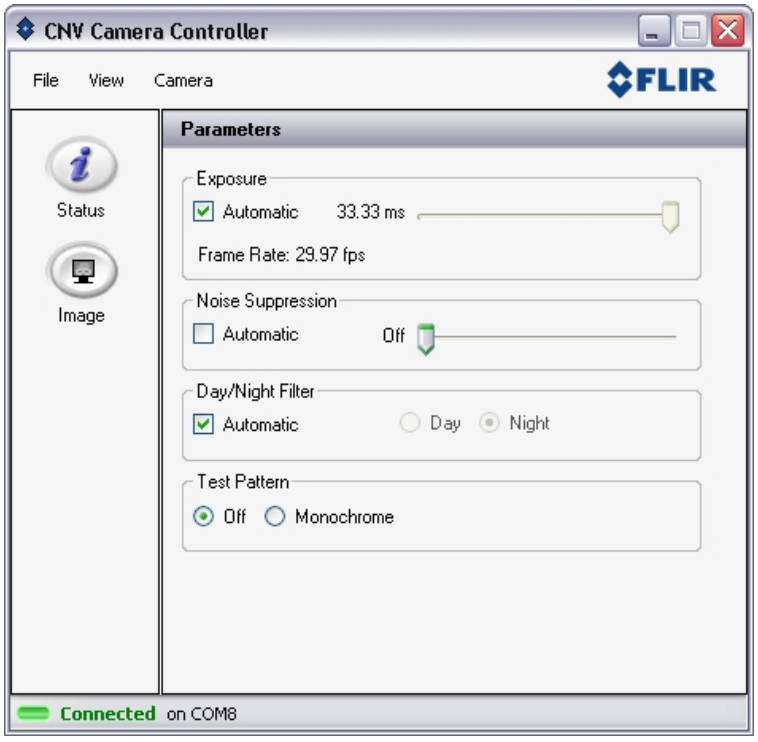
Select Camera > Connect> Connect to the camera. See the screenshot below:



If successful, the “Connected” status will appear in the lower left of the GUI window along with the camera status information as shown in the example screen shot below:

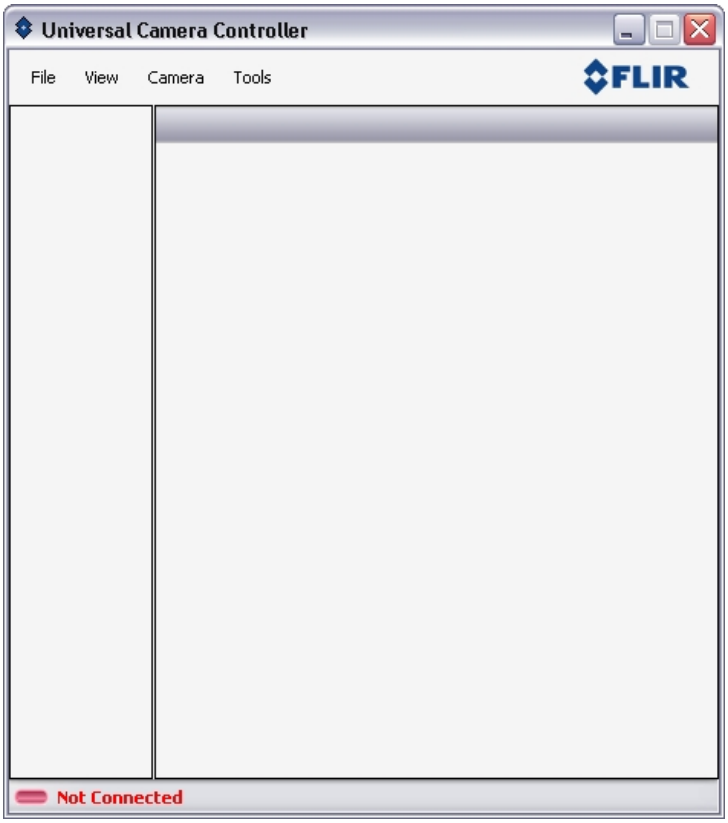


Once connected, you can click on “Image” to access options on the “Image” screen. This screen allows access to the basic controls of the camera as seen in the screenshot below.

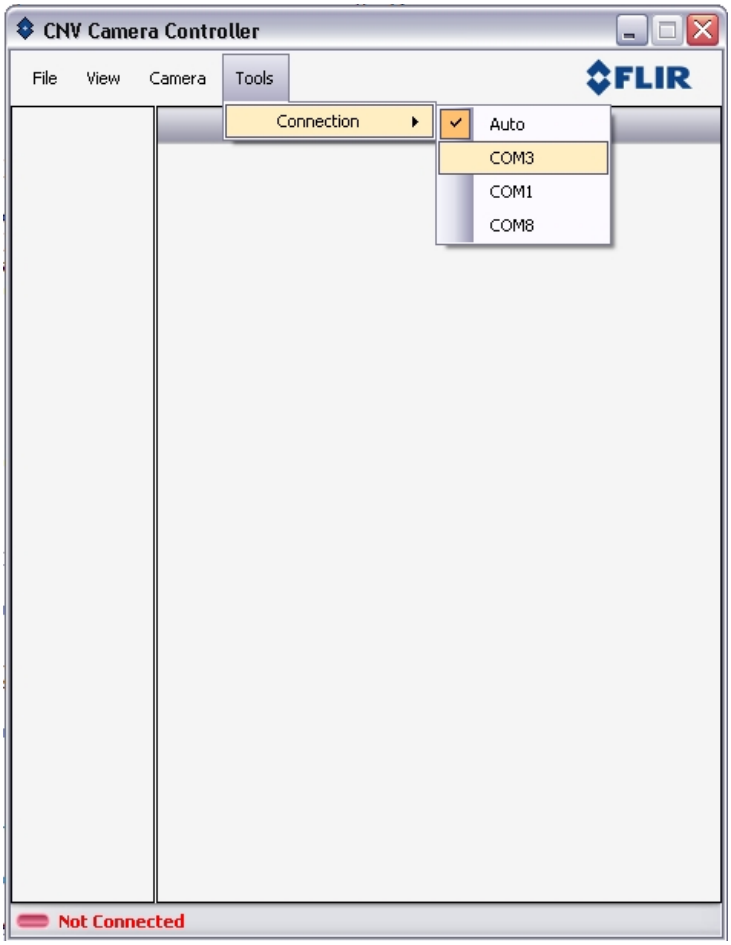


9.1.3 GUI Advanced User Mode

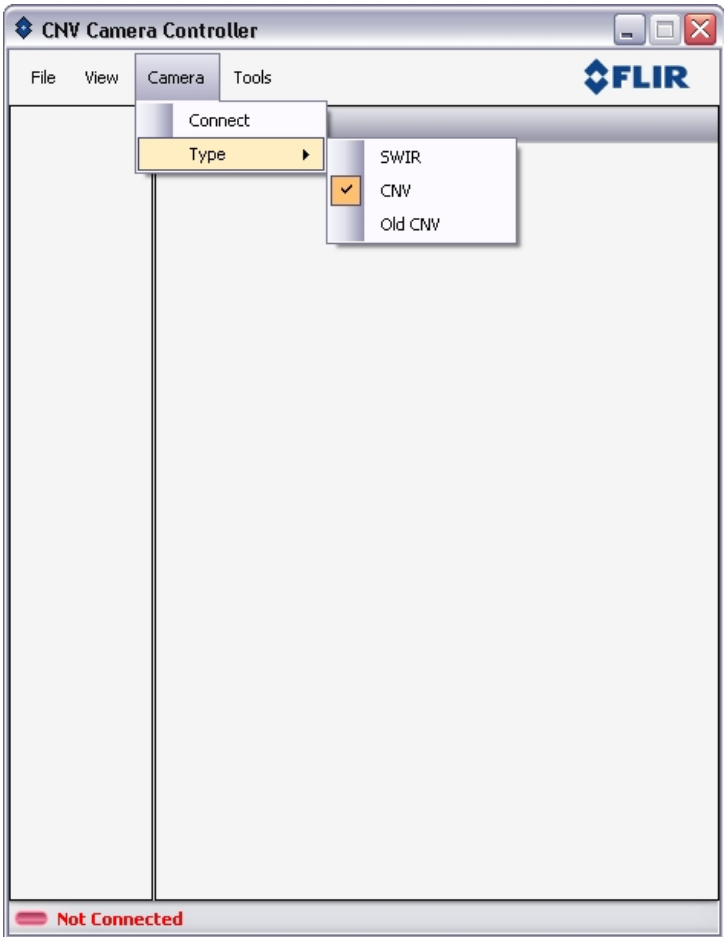
The universal camera controller GUI offers an advanced mode intended for use by experienced customers. To access the advanced user mode, press CTRL-SHIFT-M (hold CTRL and SHIFT while pressing the M key). This will bring up a password dialog. We use a password as a layer of protection. There are features in the advanced mode that can produce poor images if used improperly. Entering advanced mode indicates the user understands and accepts this responsibility. The password is "www.flir.com" (without quotes). Once the correct password has been entered, the initial connection window will be slightly different as in the following screenshot.



Notice the new "Tools" menu option. Under "Tools" you have access to manual connection options. Under the "Camera" menu option you also have a new option, "Camera Type", see the following screenshots for these:

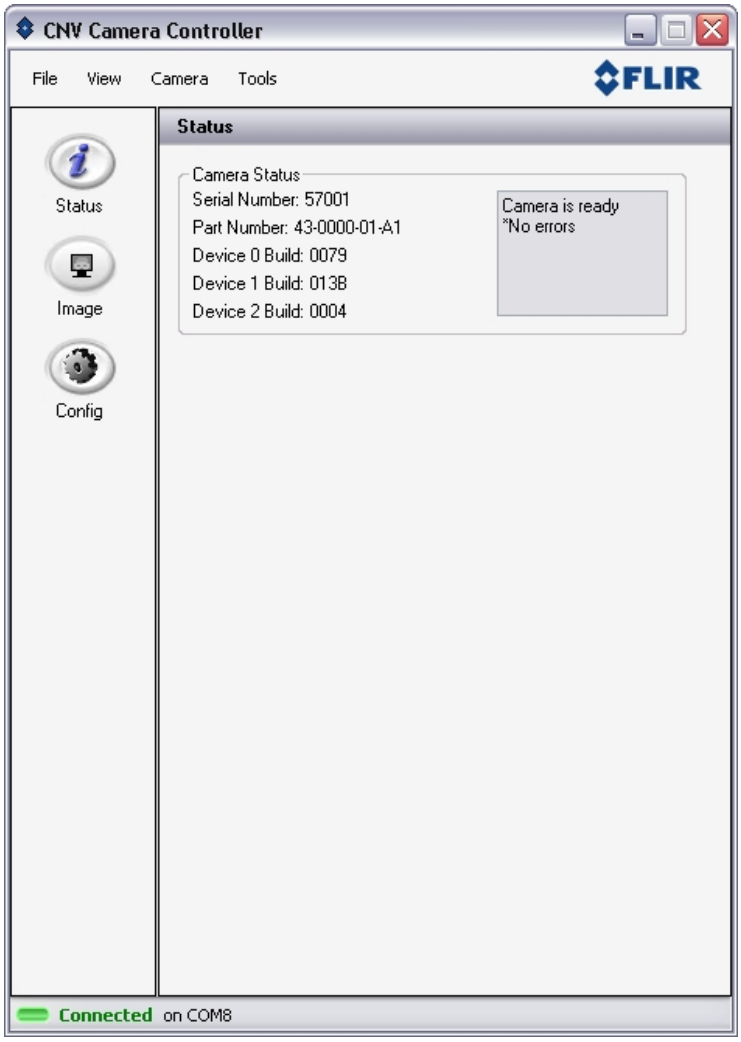


All of the available ports should show up in this screen. If a connection option isn't available here, the software is unable to see it and further troubleshooting may be required.



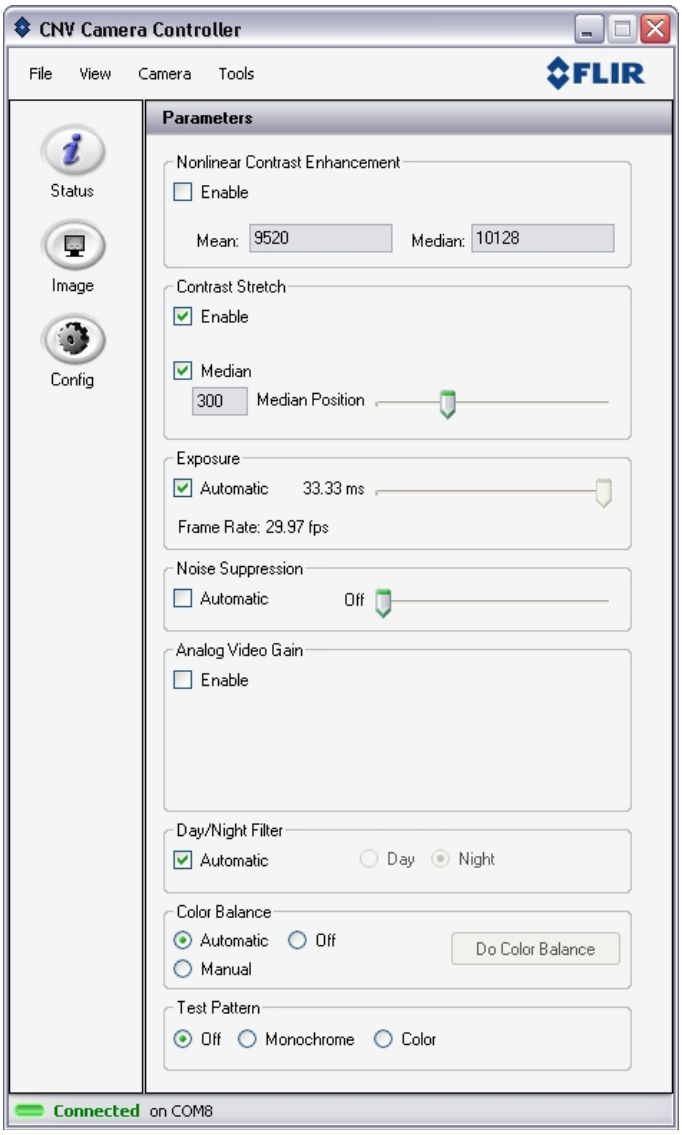
The software should automatically choose the proper camera type; however, if it does not, you can select it manually here.

The other screens have also changed. The “Status” screen will appear as follows:



As you can see from the screenshot the “Tools” menu item is still there and there is a new window button “Config”.

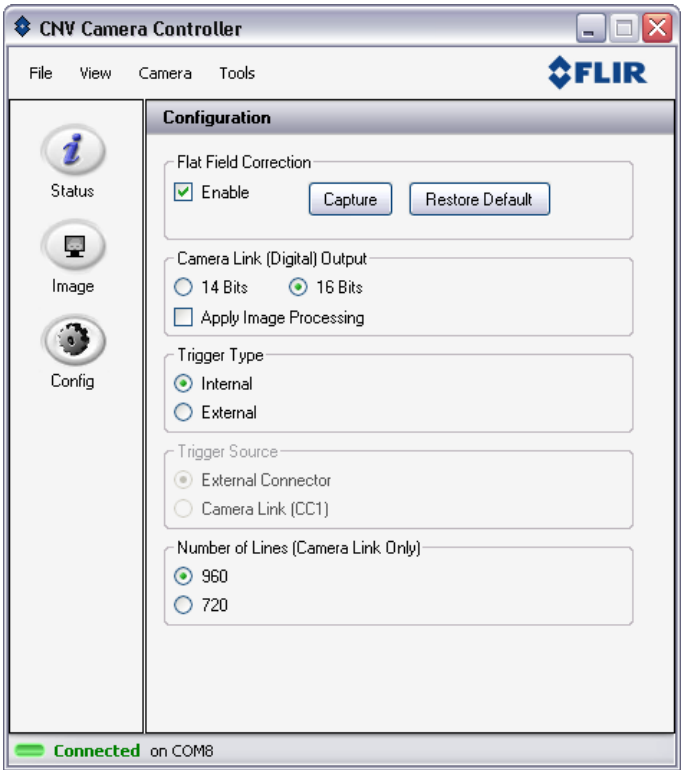
The next two screenshots indicate the changes in the window appearance for both the “Image” window and the “Config” window:



Above is the “Image” window. Note the changes from the basic user interface mode. The available functions are described here:

- **Nonlinear Contrast Enhancement –** Selects between a linear image remapping algorithm and a non-linear image remapping algorithm to remap the 16 bit data to an 8 bit analog output stream.
- **Contrast Stretch –** Stretches the contrast to enhance the detail within the image.
- **Exposure –** Selects automatic or manual exposure mode and allows the user to adjust the exposure in manual mode by sliding the slide bar.
- **Noise Suppression** – Enable or disable the automatic noise suppression algorithm and adjust the level of noise filtering applied in manual mode.

- **Analog Video Gain** – Enables or disables the main 16 bit to 8 bit analog remapping algorithm to adjust the analog image.
- **Day/Night Filter** – Moves the motorized day/night filter slider if your camera is so equipped.
- **Color Balance** – Allows the user to select automatic color balance or to perform a manual color balance.
- **Test Pattern** – Displays the test pattern.



The "Configuration" window is completely new in the advanced mode and offers the following functions:

- **Flat Field Correction –** Allows the user to perform a Non-Uniformity Correction (NUC) in the field if conditions require it. Note that this NUC will only be valid while the camera is powered on and will reset to default when the camera is power cycled.
- **Camera Link (Digital) Output** – The user can select whether the output of the digital data is 14 or 16 bits and also whether the image processing is performed prior to data output.
- **Trigger Type** – As previously mentioned, the camera can operate in two different trigger modes:
  - Internal – The camera operates at up to 30FPS on an internally generated free running clock.
  - External – The camera is synced to a signal on the external trigger input.
- **Trigger Source** – This option becomes available when an external trigger is selected. It chooses which external trigger the camera will be using.
- **Number of Lines (Camera Link Only)** – The user can select whether the output is 1280x960 or 1280x720. Note that this only affects the digital output.

- **Shutter Mode (Future – Not Implemented)** – Allows the user to select between rolling and global shutter.

10 Camera Care and Maintenance

10.1 Maintenance, Returns, and Repair

Your FLIR AIS camera should be handled with care as with any delicate high precision opto-electronic instrument. The camera should not be exposed to liquid or shock environments. Temperature and humidity should be kept within the operating and storage range specified. There are no user serviceable parts on this camera.

If an issue cannot be resolved remotely, FLIR AIS will issue a Returned Materials Authorization (RMA) for the camera. Please contact FLIR AIS support at supportais@flir.com for further information on field issues or to receive an RMA number and shipping information. If the camera is under warranty, the camera will be repaired or replaced according to the terms of the warranty. If the camera is out of warranty, the repair will be quoted on an individual basis.

10.2 Electrostatic Discharge (ESD)

Your FLIR AIS camera contains circuitry that can be damaged by electrostatic discharge. It is good practice to carry the camera in a static free container or bag. When the camera is not plugged in, the user should make sure that the working surface, and any tools used, are properly grounded.

10.3 Cover Glass Damage

The camera sensor has a protective cover glass over the sensor. If the lens mount is removed, this cover glass is exposed at the front of the camera. It can easily become scratched, soiled or damaged. It is especially difficult to remove oil from it, so avoid touching with fingers. It is best to keep the lens mount on the camera to reduce the risk of physical damage.

If the cover glass does get dirty or dusty, use clean, dry compressed air to blow away any dust. If further cleaning is required, use a lint-free, ESD safe soft cloth wipe such as a LENSX 90 (Item #:LN90.0406.24) from Berkshire and optical cleaning fluid such as Coated Optics Cleaning Fluid (Cat No. 49120) from Oriel. Proper techniques for cleaning AR coated glass should be used. See section 2.3 for important cleaning information.

10.4 Cleaning the Camera Housing

If the camera housing becomes dirty, a soft cloth with an isopropyl alcohol solution such as TechClean AbsorbWipe (Model 2351-100) from TechSpray can be used.

11 Revision Control

Rev	ECO #	Date	Initiator	Revision Description
01		10-30-2011	D. Jenkins	Pre-release draft
02		11-23-2011	D. Jenkins	Preliminary
A1	594	1-4-2012	D. Jenkins	First Release